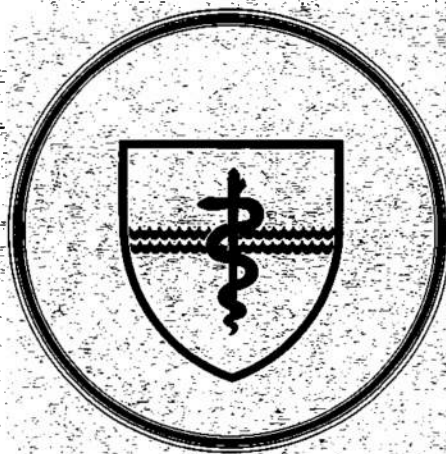


NAVAL SUBMARINE MEDICAL RESEARCH LABORATORY

SUBMARINE BASE, GROTON, CONN.



REPORT NUMBER 1008

THE STABILITY OF VISUAL FIELD MEASURES WITH REPEATED TESTING

by

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and

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Naval Medical Research and Development Command
Research Work Unit MR000.01.01-5088

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THE STABILITY OF VISUAL FIELD MEASURES WITH REPEATED TESTING

by

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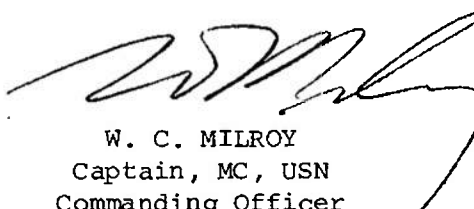
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NAVAL MEDICAL RESEARCH AND DEVELOPMENT COMMAND

Work Unit MR000.01.01-5088

APPROVED AND RELEASED BY



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SUMMARY PAGE

PROBLEM

The size of the area in which the eye can see (visual field) may be sensitive to vitamin supplementation and deficiency. Before this measure can be used in this application we must first determine the variability of visual field testing across repeated test sessions in normal subjects.

FINDINGS

Subjects with normal vision showed approximately two degrees variation in visual field extent over five sessions. Since the effect of vitamin supplementation may change visual field size as much as 10 degrees, the measure is sensitive and reliable enough to be used in a study of vitamin supplementation in submariners.

APPLICATION

This test will be used during a study of the effect of vitamin supplementation on performance during a submarine patrol.

Administrative Information

This research was performed under Naval Medical Research and Development Command Work Unit MR000.01.01-5088 - Behavioral and electrophysiological indices of environmental hazards in submariners. It was submitted for publication on 18 Aug 1983, approved for publication on 1 Sep 1983, and designated as NavSubMedRschLab Rep. No. 1008.

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ABSTRACT

Vitamin supplementation and deficiencies may affect the size of the area in which the human eye can see (visual field). Before using this measure, however, it is important to determine how reliable visual field testing is over several sessions. The size of the visual field was tested in ten subjects on five different days. Subjects with normal vision showed approximately two degrees variation in visual field extent over the sessions. This suggests that the measure can be incorporated in the test protocol designed to study the effect of vitamin supplementation during submarine patrols.

INTRODUCTION

When looking straight ahead the human eye can see in an area that is generally oval in shape. This area is called the visual field. Visual field testing has proven useful in the detection and diagnosis of damage to the visual pathways, diseases of the choroid and retina, glaucoma, and exposure to toxic substances.

The effect of nutrition on visual field size has also been investigated to a limited degree. Nutritional amblyopia has been reported in persons held prisoner in Japanese prison camps during World War II.¹ These individuals suffered rather extreme nutritional deficiency. In a less severe situation, however, nutritional effects have also been reported.² A study of visual fields in factory workers reported significant loss of visual field extent over the course of the day in workers performing intensive visual work, whereas individuals taking retinol supplements did not show losses.

Visual field testing may therefore be a useful addition to studies of nutritional or vitamin status. One of the problems with visual field testing however is that of variability of the measure. The exact size of this field depends greatly on the method of testing, the size, intensity and color of the test object, the distance at which the test object is presented and the ratio of stimulus intensity to background. Intra-subject variables will also influence the field size. These include age, fatigue, frequency of testing, size of the pupils, and degree of

dark adaptation. Individuals with myopia may also partially close their eyelids and affect visual field size in this manner.

No data appear to be available that repeatedly test the same individuals using a consistent test procedure. Before visual field testing can be included in the protocol that utilizes repeated testing it is important to determine the variability of the measure in normal individuals. This study was designed to test the variability of visual field measures across several days of testing before including the measure in a study of the effects of vitamin supplementation on cognitive and perceptual functions during prolonged submarine patrols. Vitamin supplementation is of interest to the U. S. Navy since this technique may enhance mental functioning. It is also important since vitamin deficiencies have been reported during extended patrols.^{3,4}

METHOD

Subjects: Three female and seven male members of the staff of NSMRL ranging in age from 22 to 54 volunteered to serve as subjects. Six of the subjects were emmetropes and therefore required no visual correction; three wore contact lenses while observing. The remaining subject, a severe myope, observed without his vision corrected.

Procedure: Each subject participated in five test sessions, one each on five different days. Testing was always performed at the same time of day for each subject.

The Haag-Streit Goldmann perimeter, Model 598, was used. During each test session, the subject first adapted to the background field of the perimeter for 10 min. The intensity of the background was 4 foot-Lamberts. After roughly determining the extent of the visual field, the method of constant stimuli was used to determine the points at which the subject always detected the test light (100% detection) and at which he never saw the light (0% detection). A 4 mm spot of white light was presented randomly at 2 degree intervals along two meridians, 90 and 15 degrees. The 90° meridian extends vertically straight up from the fixation point, and the 15° meridian lies 15 degrees above a horizontal line through the fixation point and on the right side of the visual field. The intensity of the test light could not be measured due to its small size, but within the visual field it was well above threshold.

RESULTS

Table I gives the mean value averaged across the 5 test days for each subject along both meridians for the 100% detection value and the 0% detection value with the accompanying standard deviations for the 90° meridian. No data are given for the subjects' 0% detection values at the 15° meridian because 8 subjects could see beyond the 90 degree field limit of the perimeter at least occasionally. No valid standard deviations could therefore be determined for these subjects. Moreover, 3 subjects consistently saw the target at the maximum testable distance along the 90° meridian.

As can be seen from the standard deviations presented in

Table I, most subjects were quite consistent over the 5 days. The mean standard deviation averaged across all subjects for the 90° meridian was less than 3 degrees for both the 100% detection value (2.76) and the 0% detection value (2.58) responses. The largest S.D., approximately 8 degrees for the 90° meridian, was shown by a severe uncorrected myope who required more than 6.5 diopters of spherical correction and 1.5 diopters of cylindrical correction in the tested eye. When the values for this anomalous subject are removed from the analysis, the mean S.D. drops to 2.17 for the 100% detection value and 1.97 for the 0% detection value for the 90° meridian.

Figure 1 shows the mean extent of the visual field and the S.D.'s for the 10 subjects for each of the 5 test days for the 90° meridian. A one-way analysis of variance showed that there were no significant differences across the 5 test days for either the 100% detection or the 0% detection value.

DISCUSSION

When consistent testing conditions are maintained, it appears that visual field testing will yield relatively stable values within a few degrees variation. Since changes of the order of 10 to 15 degrees have been reported with retinol supplementation² it should be possible to use this technique to evaluate the effect of vitamin supplementation on visual field during a submarine patrol.

One caution must, however, be mentioned. The largest standard deviations are associated with the judgments made by an extreme myope

Table I. The mean extent of the visual field (in degrees) for each subject for the two measures at the 90 degree meridian and the 100% detection measure for the 15 degree meridian. Standard deviations are also included.

S	90 Degree				15 Degree	
	100% Detection		0% Dection		100% Detection	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
1	43.6	1.67	47.2	1.79	85.6	0.89
2	35.2	8.07	37.2	8.08	76.8	5.40
3	47.2	1.10	49.2	1.09	86.0	0 **
4	56.0	2.00	60.8	1.79	90.0	*
5	35.6	4.34	38.4	4.10	84.4	1.67
6	48.4	2.61	52.0	2.00	90.0	*
7	41.6	2.19	45.6	1.67	88.0	2.45
8	44.0	0 **	46.0	0 **	85.6	1.67
9	47.2	3.03	49.6	2.61	90.0	*
10	30.4	2.61	32.8	2.68	86.4	0.89

* No standard deviation can be calculated for these values since the subject was always able to see the light at the maximum testable degree, 90°

** These values are actually zero since all five judgments by these subjects yielded the same value.

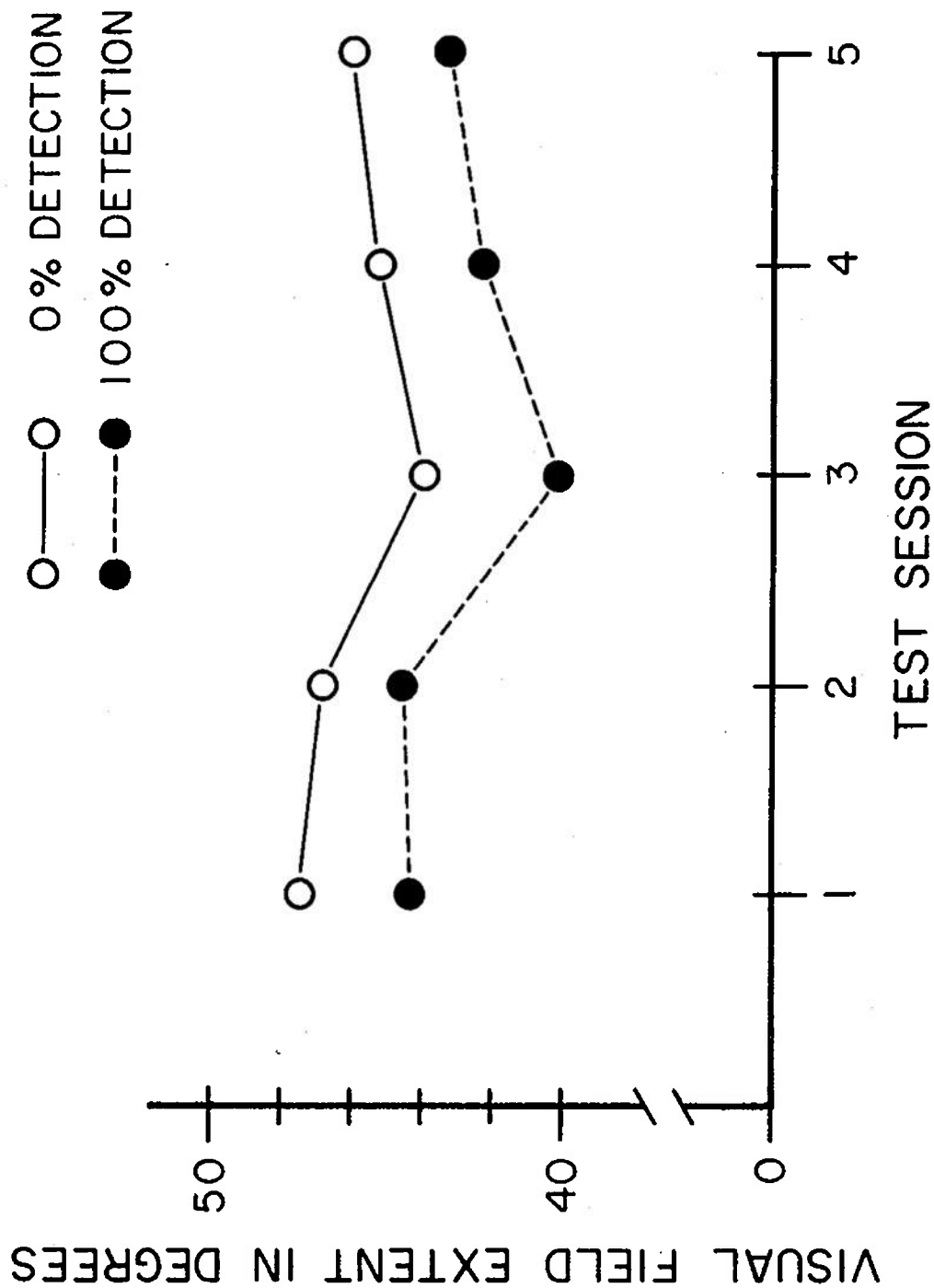


Fig. 1. The visual field extent (in degrees) for the five test sessions at which the subject always detected the stimulus light (100% detection) and never detected the stimulus light (0% detection).

(subject Number 2). Inter-session variability in visual field extent is typical of myopic individuals in a perimeter task.¹ Since the performance of myopes probably will vary over the course of several test sessions, these individuals should be excluded from visual field studies if possible.

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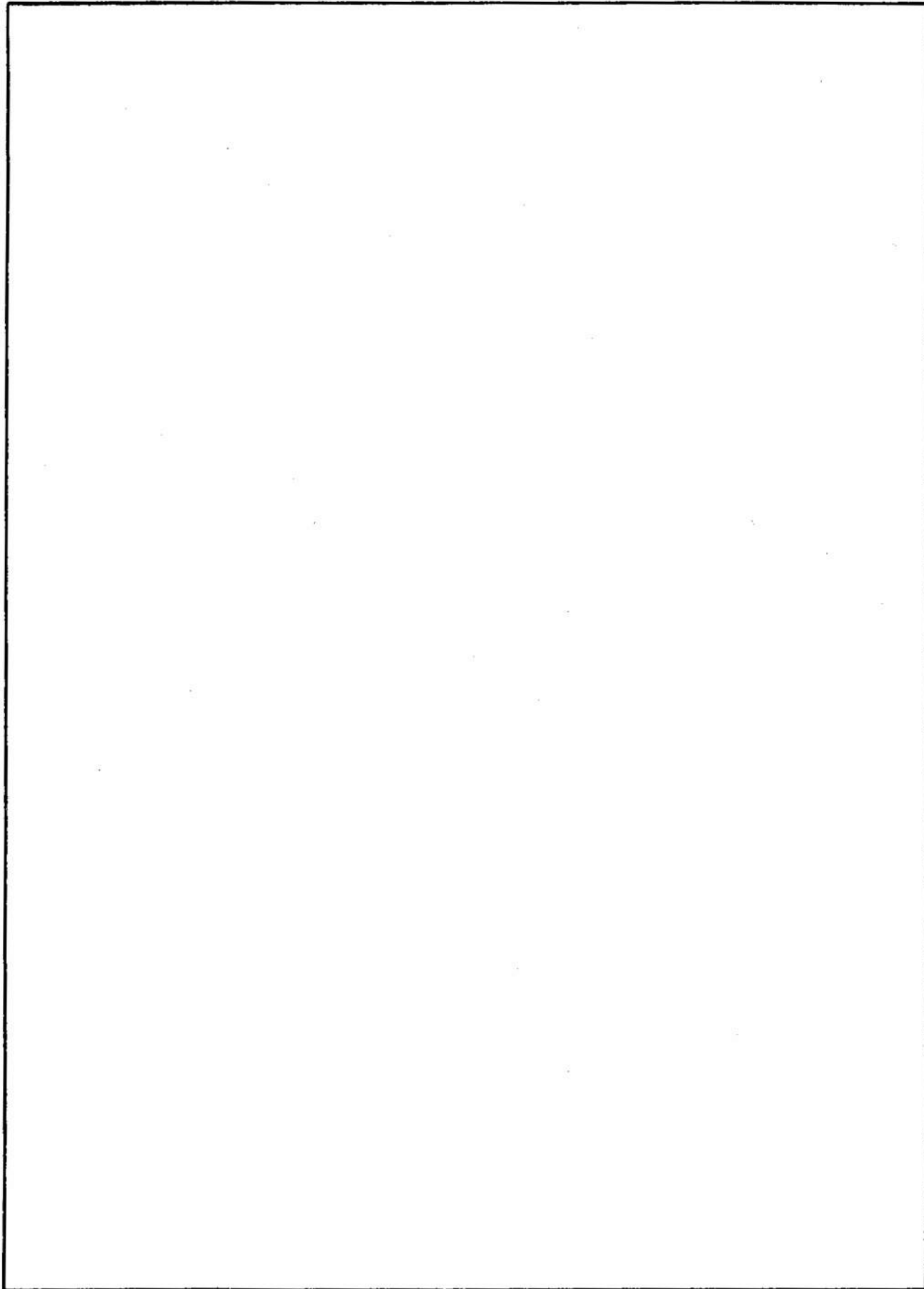
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